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A Study of the Effectiveness of two Cooling Measures for Reducing Fever in Children

Marilyn Catherine Kueffner

LOMA LINDA UNIVERSITY

School of Graduate Studies

A STUDY OF THE EFFECTIVENESS OF TWO COOLING MEASURES FOR REDUCING FEVER IN CHILDREN

by

Marilyn Catherine Kueffner

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I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Winifred M. Edwards, Chairman
Winifred M. Edwards, Associate Professor of Nursing

Betty J. Trubey
Betty J. Trubey, Associate Professor of Nursing

Nord S. Nation, M.D., Instructor in Pediatrics

Graciela E. Schaeffler, Supervisor of Pediatric Nursing

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Marilyn Kueffner

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CHAPTER I

INTRODUCTION TO THE STUDY

Some time ago while caring for a child with a high fever, the writer noted the following order: Cooling measures for temperature above 101 degrees. Three different cooling measures were listed. A desire to know the effectiveness of various methods for reducing fever in children led to the following study.

I. THE PROBLEM

Statement of the problem. The purpose of the study was to evaluate the effectiveness of two commonly used cooling measures for reducing the temperatures of infants and children with fevers due to infections. The cooling measures selected for the study were (1) immersion of the patient in water 95 degrees Fahrenheit which was gradually reduced to 75 degrees Fahrenheit, the patient remaining in the tub for a period of twenty minutes; and (2) sponging the entire body of the patient with water 75 degrees Fahrenheit.

Need for the study. Fever is associated with many of the acute illnesses common in infancy and childhood.[1] Due to the instability of the nervous system and particularly of the temperature regulating center, fever is not only frequent but often very high.[2]

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[1]Philip C. Jeans, F. Howell Wright, and Florence G. Blake, Essentials of Pediatrics (Philadelphia: J. B. Lippincott Company, 1958), p. 163.

[2]Evsay Prilla, "Fever in Children," Illinois Medical Journal, 73:420, May, 1938.

A prolonged high degree of temperature may lead to such serious complications as dehydration, convulsions[3] and possible brain damage.[4]

In cases of elevated temperature, the physician may designate a specific medication or method for reducing the fever; or he may order cooling measures, leaving the choice of the method to the discretion of the nurse.

While many hospitals designate a particular procedure for reducing fever by hydrotherapy, other hospitals may use a variety of different procedures. If the physician leaves the choice of cooling measure to the nurse, it is desirable that she have a scientific basis for the selection of a particular cooling procedure.

Common methods for reducing fever are: sponging the entire body with water of varying degrees of temperature, sponging the entire body with alcohol, application of ice bags, application of cold compresses, use of a cooling mattress, and reduction of temperature in the patient's environment. Cooling mattresses and the reduction of the room temperature are two methods generally prescribed by the physician and would not usually be chosen by the nurse when the selection of cooling measures is left to her discretion.

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[3]Ella L. Rothweiler, Jean Martin White, and Doris A. Geitgey, The Art and Science of Nursing (Philadelphia: F. A. Davis Company, 1959), p. 249.

[4]Louis Lichtenstein, "Pathological Changes Following Therapeutic Hyperthermia," American Journal of Pathology, 15:363-375, 1939.

In cases of high fever due to infections, antibiotics are frequently ordered. While they have an indirect influence on reduction of a fever, the action may not be fast enough to eliminate the possibility of complications. Various studies on patients with all types of acute bacterial infections, including streptococcal disease, meningitis, and pneumonia, who have been treated with antibiotics show that there is no appreciable drop in temperature in less than 24 to 48 hours.[5] The administration of an antibiotic, therefore, does not cancel the need for cooling measures.

A survey of literature revealed no studies on the comparative effectiveness of cooling measures used to reduce fever due to infections in children. It is because of this that two of the commonly used cooling measures were selected for study.

II. THE HYPOTHESIS

The following hypothesis was tested in this study: Immersion in a tub of warm water gradually lowered to cool is more effective in the reduction of fever due to infection than is sponging with cool water.

III. DEFINITIONS OF TERMS

Immersion. Immersion is the placement of the patient in a tub of water so that the water covers all of the body up to the waist. Water is applied to the arms, upper chest and upper back by

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[5]Louis S. Goodman and Alfred Gilman, The Pharmacological Basis of Therapeutics (New York: The MacMillan Company, 1955), pp. 1321-1413.

hand during the time that the patient is in the tub.

Sponging. Sponging is the application of water to the body by means of a washcloth and administered with slight friction. For the purposes of this study, the term sponging indicates that each body part has been covered with ten strokes, five up and five down.

Cool. Cool is defined as 75 degrees Fahrenheit.

Warm. Warm is defined as 95 degrees Fahrenheit.

IV. THE ASSUMPTION

For the purpose of this study, it was assumed that any antipyretic or other cooling measure administered within four hours previous to the administration of the cooling measure would alter the reaction of the cooling method being tested.

V. THE LIMITATIONS

The limitations of this study were as follows:

1. The subjects selected were age six months to three years.
2. The subjects selected had fever resulting from an infection.
3. It was difficult physiologically to match the subjects in the two groups.
4. The temperature and humidity of the room in which the treatment was given varied.

VI. THE METHOD USED

The experimental method with a parallel group technique was used for the study. The subjects were selected from the pediatric wards and clinics of two specific general hospitals.

Basis for the selection of subjects. Subjects were selected on the following basis:

1. They had a rectal temperature of 102 degrees F. or over.
2. Infection was designated as the cause of the fever.
3. They were six months to three years of age.
4. No aspirin or other cooling measure had been received within four hours.

Collection of data. The subjects were divided into two groups. One group was designated as Group A and the other group as Group B. The subjects in the two groups were matched as closely as possible on two factors, body surface area and age.

The subjects in Group A were sponged with cool water. They were not dried with a towel following the sponging of each part but were allowed to dry by evaporation. The subjects in Group B were placed in a tub of warm water. Within five to seven minutes the water was reduced to 75 degrees F. The subjects remained immersed in the water for a total of twenty minutes, after which they were immediately wrapped in a bath blanket and gently dried.

A rectal temperature was taken before applying the cooling measure and at 15 minutes, 30 minutes, 45 minutes, and 60 minutes following the administration of the cooling measure. The thermometer

was inserted into the rectum to a depth of 2.5 cm. and held in place for three minutes.

The effectiveness of the treatment was evaluated in relationship to the drop in body temperature which was measured by a thermometer.

VII. SUMMARY

Since fever is frequent and often very high in children and since cooling measures are routinely ordered for elevated temperatures, this study was done to evaluate the effectiveness of two specific techniques: immersion in a tub of warm water gradually reduced to cool, and sponging with cool water.

CHAPTER II

REVIEW OF THE LITERATURE

DuBois, a prominent figure in the study of fever, makes the following remark in the opening passage of his book, Fever and the Regulation of Body Temperature:

> Fever, one of the most dramatic manifestations of disease, has been studied by physicians since the time of Hippocrates. It has been accepted as an aid in diagnosis and prognosis and has been fought as though it were both a disease and a symtom. It is so common that it seems simple and we take it for granted that sick people will develop fever.[6]

In the child, fever is a usual symptom of acute illness. Jeans, Wright, and Blake state that, "In the early stages of infection a sharp rise in body temperature to 102 - 104 degrees F. or even higher is common."[7] Fevers rise to greater heights in the child than they would in adults with the same disease. Prills explains this on the basis of the unstable nature of the nervous mechanism and particularly of the heat regulatory center in infants.[8]

A review of literature was made to more fully understand the mechanism of heat production and heat loss and to determine what studies had been done on the reductions of fever by hydrotherapy techniques.

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[6]Eugene F. DuBois, Fever and the Regulation of Body Temperature (Springfield, Illinois: Charles C. Thomas Publisher, 1948), p. 3.

[7]Jeans, Wright, and Blake, op. cit., p. 109.

[8]Prills, loc. cit.

I. THE NORMAL BODY TEMPERATURE

An oral temperature of 98.6 degrees is the commonly accepted normal body temperature. The rectal temperature averages 0.6 of a degree higher than this.[9] It is also recognized that there are variations of this figure for different individuals and for the same individual under varying circumstances. A study by Van der Bogert and Moravec on body temperatures in apparently healthy children confirms this point.[10]

There are also variations in temperature in different parts of the body. Best and Taylor state that the temperature of the internal organs is higher by several degrees than that of the skin,[11] while DuBois indicates that the skin may be 2 - 4 degrees cooler than the interior.[12] A study by Talbot on temperature variations of the body agrees with the above statements.[13]

At birth the heat-regulating mechanisms are not fully developed. Best and Taylor state that this may result in spontaneous

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[9]Charles Herbert Best and Norman Burke Taylor, The Physiologic Basis of Medical Practice (Baltimore: The Williams and Wilkins Company, 1961), p. 884.

[10]Frank Van der Bogert and Clayton L. Moravec, "Body Temperature Variations in Apparently Healthy Children," Journal of Pediatrics, 10:466-471, 1937.

[11]Best and Taylor, loc. cit.

[12]DuBois, loc. cit.

[13]Fritz B. Talbot, "Skin Temperatures of Children," American Journal of Diseases of Children, 42:965-1044, October, 1931.

variations of from 1 - 2 degrees F. during the first year.[14] Bosma and Kelley state that although normally physiologic regulation becomes adequate in the first three months of life, it may fail to compensate for extremes of heat or cold for a prolonged period.[15]

II. HEAT LOSS AND HEAT PRODUCTION

Bosma and Kelley make the following statement regarding heat loss and gain:

> The precise mechanisms involved in the hemostasis of the body temperature are but incompletely understood despite numerous investigations of the subject over a period of many years. It is clear that various organ systems of the body participate in this regulation and contribute to the physiologic balance which is maintained usually without conscious effort, between heat loss and heat gain.[16]

As indicated by DuBois, heat production is furnished to the body by metabolism of protein, fat, and carbohydrate. Exercise, unconscious tensing of the muscles without overt movement, and involuntary shivering resulting from exposure to extreme cold are also factors involved in heat production.[17]

Heat is lost from the body through radiation, convection, conduction, evaporation of water from the lungs and skin, raising

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[14]Best and Taylor, loc. cit.

[15]James F. Bosma and Vincent C. Kelley, "Body Temperature Regulation in Health and Disease" in Brenneman's Practice of Pediatrics, Vol. I, Vincent C. Kelley (ed.), (Hagerstown, Maryland: W. J. Prior Company, Inc., 1960), Chapter 5, p. 9.

[16]Ibid., p. 1.

[17]DuBois, op. cit., pp. 10-11.

the inspired air to body temperature, and through the elimination of urine and feces.[18]

Bosma and Kelley suggest an explanation for heat loss.

> Heat loss is controlled by changing the temperature gradients from the interior of the body to its surface, by changing the amount of sweat available for evaporation from the body surface, by changing the character and contours of the body surface, by gross body motions and by variations in the amount of pulmonary ventilation.[19]

They further discuss the significance of environmental temperature, humidity, and air movement in controlling the body temperature. While the insulating effect of still air is great, it may be reduced by increasing the effective body surface. This may be accomplished by spreading the limbs and thus achieving a greater heat exchange between the body and its environment.[20] Neurological and endocrine mechanisms have a definite part in temperature control.

III. FEVERS FROM INFECTIONS

Best and Taylor categorize fever into five types including (1) infectious fever such as typhoid, pneumonia, etc., (2) surgical fever which arises after an extensive aseptic operation, (3) neurogenic fever from injuries to the nervous centers, (4) fever of dehydration due to reduction of blood water, and (5) fever produced by drugs and other chemical substances.[21]

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[18]Best and Taylor, op. cit., p. 885.

[19]Bosma and Kelley, op. cit., p. 3.

[20]Ibid., pp. 3-4.

[21]Best and Taylor, op. cit., p. 894.

Two mechanisms are involved in the physiology of fevers due to infections. The heat balance is upset by (1) a reduction in heat loss as a result of vasoconstriction and a reduction and redistribution of blood flow and (2) an increase in heat production.[22] The toxin of the infecting organism acting on the heat regulating centers in the hypothalmus triggers the reduction in heat elimination and the increase in heat production. The decrease in heat loss is of greater significance than the increased heat production.[23]

Often the patient with an infectious fever may experience what is known as a chill. This is due to the fact that the heat conserved by the redistribution of blood flow does not raise the internal temperature fast enough. The violent shivering which occurs at this time causes a constriction of the skin vessels with a resulting rise in the internal temperature. The fact that not only heat loss is decreased but heat production increased results in an increase in temperature. DuBois demonstrated by experiment that during a chill heat elimination of a man with malaria was greatly reduced.[24]

IV. THE ANTIPYRETIC ACTION OF DRUGS

An antipyretic drug is often ordered by the physician to be given in conjunction with the cooling measure. Because of this fact, a limited review of the antipyretic effect of the salicylates was

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[22] Ibid., p. 895.

[23] Ibid.

[24] DuBois, op. cit., p. 22.

made. The results of a study by Barbour indicated that acetylsalicylic acid exerted little effect upon normal temperature, but markedly reduced temperature in fever.[25]

Goodman and Gilman explain the action of the salicylates to reduce fever in the following manner:

> In fever the balance between heat production and heat loss persists except that the "thermostat" (hypothalmus) is set at a higher level. The salicylates act to reset the "thermostat" for normal temperature. Heat production is not inhibited but heat dissipation is augmented by increased peripheral blood flow and sweating.[26]

A study by Vignec and Gasparik on the antipyretic effectiveness of salicylamide and acetylsalicylic acid in infants indicated that with both drugs the need for added therapy increased in direct relationship to the height of the initial temperature.[27]

It is the opinion of Giesel that the use of aspirin should be avoided in the infant under one year of age because of an occasional idiosyncrasy to the drug at this age. "Prolonged use," he stated, "should also be avoided because of the possible accumulation in the body with resultant toxic symptoms." Bleeding may occur due to a decrease in the prothrombin level.[28]

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[25]Henry G. Barbour, "Antipyretics III. Acetylsalicylic Acid and Heat Regulation in Fever Cases," Archives of Internal Medicine, 24:624-32, 1919.

[26]Louis S. Goodman and Alfred Gilman, The Pharmacological Basis of Therapeutics (New York: The MacMillan Company, 1955), p. 283.

[27]Alfred J. Vignec and Mary Gasparik, "Antipyretic Effectiveness of Salicylamide and Acetylsalicylic Acid in Infants," Journal American Medical Association, 167:1821-6, 1958.

[28]Louis O. Giesel, "Fever Control in the Office and the Home," Pediatric Clinics of North America, 8:73-5, February, 1961.

Alvarez and Summerskill support a causal relationship between salicylate consumption and massive gastrointestinal hemorrhage.[29] Hurley, et al., while accepting the fact that enormous amounts of aspirin are ingested with apparently no ill effects, consider that experimental as well as statistical evidence indicates that salicylates can account for serious gastric disturbances, particularly bleeding.[30]

V. HYDROTHERAPY FOR REDUCING FEVER

"Hydrotherapy or medical hydrology is the external or internal application of water in its solid, liquid, or vapor form for healing purposes."[31]

Finnerty and Corbitt indicate that water may be used to abstract and reduce the temperature of the body or body part by means of conduction, radiation, convection, and evaporation.[32] Water will remove heat from the body if its temperature is lower than that of the part that has been immersed. "The results obtained by the general application of water to an individual depend upon the following factors: The degree of difference that exists between the temperature

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[29]A. S. Alvarez and W. H. J. Summerskill, "Gastrointestinal Haemorrhage and Salicylates," Lancet, 2:920-25, November 1, 1958.

[30]J. W. Hurley, et al., "Salicylates and the Stomach," Journal of the Indiana State Medical Association, 53:84-7, January, 1960.

[31]Gertrude Brentano Finnerty and Theodore Corbitt, Hydrotherapy (New York: Frederick Ungar Publishing Company, 1960), p. 13.

[32]Ibid., p. 16.

of the skin and that of the water applied, the method by which the water is applied; the suddenness of application; the extent of surface covered; and the duration of the treatment."[33] Severe cold when applied to the body for a brief time causes shivering with consequent heat production and reduction of heat elimination. When cold is applied for an extended period, the system gradually loses its power to resist the depressing effects of the cold, and its antithermic effects are developed.[34]

According to Nylin, febrile patients show a more pronounced and more lasting fall in temperature as a result of cold procedures than people in health, particularly if simultaneous mechanical stimulation is administered in conjunction with the treatment.[35] Kellogg reports that Currie showed by thermometric observations that applications of cold water to the surface of the body are capable of lowering not only the surface temperature but also the internal temperature of the body ("Medical Reports," London, 1795).[36]

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[33]John S. Coulter and George M. Piersol, "Hydrotherapy," in Physical Medicine and Rehabilitation published by the American Medical Association (Philadelphia: The Blakiston Company, 1950), p. 175.

[34]J. H. Kellogg, Rational Hydrotherapy (Philadelphia: F. A. Davis Company Publishers, 1904), p. 127.

[35]Josef B. Nylin, "Hydrotherapy" in Principles and Practice of Physical Therapy, Vol. III, Harry E. Mock, Ralph Pemberton, and John S. Coulter (eds.), (Hagerstown, Maryland: W. F. Prior Company, Inc., 1933), Chapter 20, p. 2.

[36]Kellogg, op. cit., p. 125.

In two recent studies[37,38] of critically ill patients with fevers caused by a variety of conditions, a cooling mattress (Therm-O-Rite machine) was used. The age range was from six to eighty-four years with a median age of fifty-nine years. The investigators indicated that no obvious harm resulted from the treatment and some patients, particularly those with central nervous system injury, appeared to have been significantly benefited.

Wyndham, et al. report a study in which six different types of cold applications were used to reduce temperatures of 106 degrees artificially produced in healthy individuals.[39] An interesting study conducted by Eichna indicated that when ice was applied to the skin, the skin temperature dropped while the rectal temperature remained unaltered. After the removal of the ice, the skin temperature rose and the rectal temperature fell.[40]

Many authors, including Fantus[41] and Barbour,[42] advocate the

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[37]F. John Lewis, "The Treatment of Fever with Surface Cooling," The Surgical Clinics of North America, 39:177-82, February, 1959.

[38]F. John Lewis, Dean M. Ring, and John F. Alden, "A Technique for Total Body Cooling of the Febrile, Gravely Ill Patient," Surgery, 40:465-70, September, 1956.

[39]C. H. Wyndham, et al.,"Methods of Cooling Subjects with Hyperpyrexia," Journal of Applied Physiology, 14:771-76, 1959.

[40]Ludwig W. Eichna, "Thermal Gradients During Varying Body Temperatures," Archives of Physical Medicine, 29:687-97, November, 1948.

[41]Bernard Fantus (ed.), "The Therapy of the Cook County Hospital," Journal of the American Medical Association, 103:484-91, August 18, 1934.

[42]Henry Barbour, "Antipyretic Measures," Canadian Medical Association Journal, 13:420-22, 1923.

use of hydrotherapy for reducing fever. Specific procedures indicated were cold head compress, antipyretic pack, sponging, sheet bath, half bath, and full bath. No studies were found on the effectiveness of different cooling measures for reducing infectious fever in infants and children.

VI. SUMMARY

Fever is a common symptom of illness in the child. Elevation of temperature due to an infection results from an upset in heat balance with a reduction in heat loss and an increase in heat production. Various cooling measures and medications have been recommended for the reduction of fever. While several studies have been conducted on the effectiveness of different antipyretic drugs, no studies were found on the effectiveness of different cooling measures for reducing infectious fever in infants and children.

CHAPTER III

METHOD OF PROCEDURE AND COLLECTION OF DATA

The purpose of this study was to evaluate the effectiveness of two commonly used procedures for reducing the body temperatures of infants and children with fevers due to infections. The two procedures studied were immersion in warm water reduced to cool and sponging the body with cool water.

The experimental method with a single variable was chosen for the study. Good makes the following statement regarding this research approach. "In experimentation the investigator controls (manipulates or changes) certain independent variables and observes the changes that take place in the form of dependent variables."[43]

While a review of literature provided no studies in which sponging and tubbing were used for reducing fever in children, it did reveal a variety of hydrotherapy techniques used for antipyretic purposes. The studies in which drugs were used for reducing temperatures provided suggestions for the method of collection and the analysis of data which proved helpful in this study.

I. METHOD OF APPROACH

Selection of facilities. Infants and children with fevers on the pediatric ward and pediatric clinic of the White Memorial Hospital were selected for the study. The capacity of the ward is 43 patients.

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[43]Carter V. Good, Introduction to Educational Research (New York: Appleton-Century-Crofts, Inc., 1959), p. 358.

During the months of January, February, and March of 1962, the daily average number of patients was 24.8. The number of patients seen in the clinic varied depending upon the type of clinic scheduled.

After talking with the pediatric supervisor, it was felt that an adequate number of patients could be obtained within the time limit of the study. As the study progressed, it was found that this was not so.

Arrangements were then made to also use the facilities of the Loma Linda Sanitarium and Hospital pediatric ward and teaching clinic. This facility was chosen primarily because of the convenience of the location.

Selection of the patients. Patients with the following qualifications were included in the study:

1. A rectal temperature of 102 degrees F. or over.
2. Age six months to three years.
3. Infection designated as the cause of the fever.
4. No aspirin or cooling measures received within four hours.

A review of literature revealed several factors that were influential in determining the basis for patient selection. According to Armstrong, "The greatest danger of prolonged high fever in children up to three years of age is spasm or convulsion." She further states that it is because of this fact that most pediatricians order measures to reduce fever when the temperature reaches 102 degrees F. or above.[44] Other authors while indicating that measures

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[44]Inez L. Armstrong, The Nursing Care of Children (Philadelphia: F. A. Davis Company, 1958), p. 172.

should be used for reducing a high fever do not state any specific degree of temperature at which to begin treatment.

Infections of the upper respiratory tract are particularly common in infants and children. These infections may have a variety of causative organisms including viruses and bacteria. Streptococcal fevers in childhood are most severe and most frequent between the ages of six months and three years.[45]

It was felt that infants below the age of six months should not be included because of the instability of the heat regulating center.

Goodman and Gilman state that the antipyretic dose of salicylates may be administered every three to four hours.[46] Sollman indicates that with a single dose the antipyretic drug reaches its maximum effect in about two hours, and then gradually declines.[47] It was felt, therefore, that if the patient had received no antipyretic drug within four hours the results of the cooling measures used in the study would not give a false picture. While no information was found regarding the length of time that the body is affected by various hydrotherapy procedures, it was assumed that if no cooling measure had been received within four hours previous to the application of the experimental method the results would not be

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[45]Clifford G. Grulee and R. Cannon Eley, The Child in Health and Disease (Baltimore: The Williams and Wilkins Company, 1952), p. 317.

[46]Goodman and Gilman, op. cit., p. 297.

[47]Torald Sollman, A Manual of Pharmacology (Philadelphia: W. B. Saunders Company, 1957), p. 722.

unduly influenced.

Selection of method. The experimental method was selected for this study. The patients were placed in one of two groups, A and B. It was impossible to have any plan for placing patients in either group because of the type of illness of the subjects or their location. An attempt was made to match the patients in relationship to age and body surface area and to place them in the groups accordingly as the study progressed. Those in Group A were sponged with cool water and those in Group B were immersed in a tub of warm water gradually reduced to cool.

The matching of the patients in the groups was on the basis of age and body surface area. The body surface area was calculated by using the nomogram made by R. R. Hannon for estimating the surface areas of children according to the formula by DuBois and DuBois.[48] It was difficult with the limited number of patients to match them as accurately as could be desired.

Selection of the technique. Sponging was the cooling measure used on patients placed in Group A.

All clothing was removed with the exception of the diaper. A wash cloth slightly wrung out was used to administer the water which was 75 degrees F. First the face was sponged. Then each part of the body including the arms, chest and abdomen, legs, and back received

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[48]Eugene F. DuBois, Basal Metabolism in Health and Disease (Philadelphia: Lea and Febiger, 1936), p. 135.

ten strokes, five up and five down. Special attention was given to the axillary and the groin areas as both the axillary arteries and femoral arteries are superficially located at these points.[49] Gentle friction was used to enhance the reaction.[50]

While various authors recommend sponging for a designated period of time, it was not used in this study because of the varying size of the patients.[51,52] In order to obtain a more prolonged effect, the body parts were not dried following the procedure.[53]

McClain and Gragg make the following statement to support the reason for not drying the patient:

> In the sponge bath evaporation is used as the cooling process. To evaporate, a liquid must draw heat from some source nearby. The temperature of the skin is lowered because it gives up heat in the process of vaporization.[54]

The child remained uncovered following the procedure for one hour. Close observation was made for any signs of chilling during the procedure and for one hour following the treatment.

Immersion in a tub of water was the cooling measure used on patients in Group B.

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[49]Henry Gray, Anatomy of the Human Body, Charles Mayo Goss (ed.) (Philadelphia: Lea and Febiger, 1959), pp. 653, 699.

[50]Simon Baruch, An Epitome of Hydrotherapy (Philadelphia: W. B. Saunders Company, 1920), p. 39.

[51]L. Emmett Holt, Jr. and Rustin McIntosh, Holt Pediatrics (New York: Appleton-Century-Crofts, Inc., 1953), p. 85.

[52]Finnerty and Corbitt, op. cit., p. 93.

[53]Coulter and Piersol, op. cit., p. 183.

[54]M. Esther McClain and Shirley Hawke Gragg, Scientific Principles in Nursing (St. Louis: The C. V. Mosby Company, 1958), p. 298.

The patient was placed in a tub of water 95 degrees F. Within five to seven minutes the temperature of the water was reduced to 75 degrees F. Nylin states that "when the principal object of the cold water is to lower body temperature, it may be advisable to reduce the temperature of the water gradually during the treatment in order to keep the augmentation of heat production at a minimum level."[55] This procedure is also recommended by Holt and McIntosh.[56]

The patient remained in the water for a total period of twenty minutes. During this time, mechanical stimulation in the form of gentle rubbing was applied to the body parts. A cold still bath causes a reduction in body heat loss due to the vasoconstriction of cutaneous blood vessels. When friction is applied at the same time, vasodilatation occurs and heat is lost from the body.[57,58]

Body temperature will fall when a cold bath is continued for a period of time. This is due to the fact that the vascular defense mechanism becomes insufficient to cope successfully with the demand placed upon it to constrict the blood vessels and conserve heat.[59]

Following the procedure the patient was immediately wrapped in a light cotton bath blanket and thoroughly and gently dried. Close observation was made for any signs of chilling during the procedure and for one hour following treatment.

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[55] Nylin, op. cit., p. 9.

[56] Holt and McIntosh, loc. cit.

[57] Nylin, op. cit., p. 2.

[58] Finnerty and Corbitt, op. cit., p. 20.

[59] Nylin, loc. cit.

All patients' temperatures were taken immediately before beginning the cooling measure and fifteen, thirty, forty-five and sixty minutes following the procedure. The thermometer was inserted into the rectum to a depth of 2.5 cm. and was held in place for three minutes. The depth of insertion of the thermometer was selected after a review of a study by Van Puymbrouck.[60]

Selection of the evaluation instrument. Chieftain thermometers were used throughout the study. They were marked with red lacquer to insure an accurate depth of insertion for each patient. A Taylor bath thermometer was used to measure the temperature of all water used in the procedures during the study.

II. COLLECTION OF DATA

In both hospitals permission to use the clinical facilities was obtained. The director of nursing service and the supervisors of the departments were personally visited. The physicians in charge of the pediatric wards were also contacted for approval of the procedures to be used. At the White Memorial Hospital the study was explained to the resident physician as his cooperation was essential for carrying out the study.

During the time available for the study, aspirin was withheld until the completion of the experimental procedure and for one hour following the treatment.

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[60]Marlene Van Puymbrouck, "A Comparison of Rectal and Axillary Temperatures on One Hundred Selected Newborn Infants" (unpublished Master's thesis, College of Medical Evangelists, Loma Linda, California, 1961).

Data were collected over a period of fourteen weeks. The investigator was on call for notification of infants and children with fever approximately thirty to seventy hours each week.

All data were collected by the investigator to insure greater accuracy in the technique used. A special form was used for recording the necessary information.[61]

III. PROBLEMS ARISING DURING THE COLLECTION OF DATA

Several difficulties arose during the study. The greatest was the lack of a sufficient number of cases. It was a problem to find a sufficient number of patients who could be given a cool tub bath. Two reasons accounted for this. In some departments space and facilities were inadequate for this procedure. It was often impossible to use hospital patients because of their condition and the various other therapies that they were receiving simultaneously.

Other difficulties included failure to be notified when patients were available and the administration of an antipyretic drug just prior to giving the cooling measure.

Although it was recognized that the room temperature and humidity had a definite influence on the effect of the procedure, it was not possible to control this factor.

Originally it was planned to conduct a pilot study. Because of the scarcity of patients who met the qualifications of the study this was not possible. The technique of administering the two cooling

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[61]See Appendix.

measures was perfected on patients with fever due to causes other than infection.

IV. SUMMARY

The experimental method was used to evaluate the effectiveness of two cooling measures for reducing fever due to infections in infants and children. Patients in Group A were sponged with water of 75 degrees F. and allowed to dry by evaporation. Patients in Group B were immersed for twenty minutes in a tub of water. The temperature of the water was gradually reduced from 95 degrees F. at the onset of the treatment to 75 degrees F. Following the procedure they were immediately wrapped in a cotton bath blanket and thoroughly but gently dried. The effectiveness of the treatment was evaluated by taking a rectal temperature before administering the cooling measure and fifteen, thirty, forty-five, and sixty minutes following the procedure.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

This experimental study was done to evaluate the effectiveness of two commonly used cooling measures for reducing fever in infants and children. Ten patients were sponged with water 75 degrees F. and seven patients were immersed in tubs of water 95 degrees F. which was gradually reduced to 75 degrees F. The effectiveness of the treatment was evaluated in relationship to the drop in rectal temperature fifteen, thirty, forty-five, and sixty minutes following the treatment.

I. PRESENTATION OF DATA

Diagnosis of the patients. All patients selected for the study had fever due to an infection. The diagnosis was obtained from the patients' charts. Table I indicates the diagnosis of the patients in Group A who were sponged and the diagnosis of the patients in Group B who were immersed.

Age of the patients. With one exception, all patients selected for the study were between the ages of six months and three years. One patient in Group B was five and one-half months of age. This patient was included in the category of patients six months to twelve months. Table II indicates the ages of the patients in Group A and Group B.

Body surface area. An attempt was made to place patients with approximately the same body surface areas in each of the two groups.

Because of the small number of patients available, this was not always possible. Table III indicates the body surface area of the patients in Groups A and B.

TABLE I

DISTRIBUTION OF CASES BY DIAGNOSIS

Diagnosis	Sponging	Immersion
Bronchopneumonia	2	2
Exudative tonsilitis		1
Fever of undetermined origin		1
Gastroenteritis	2	
Lobar pneumonia		1
Meningitis	1	
Otitis media	2	
Otitis media, pharangitis	2	
Otitis media, upper respiratory infection		1
Pharangitis		1
Pneumonitis	1	

TABLE II

DISTRIBUTION OF CASES BY AGE

Age	Sponging	Immersion
6 - 12 months	4	5
13 - 18 months	2	2
19 - 24 months	2	
24 - 30 months	1	
31 - 36 months	1	

Initial temperature. A temperature was taken on all infants immediately preceding the cooling measures. While a rectal temperature of at least 102 degrees F. was required, the initial temperatures varied from 102 to 105.2 degrees F. Table IV indicates the initial temperatures of the patients in Group A and Group B.

TABLE III

DISTRIBUTION OF CASES BY BODY SURFACE AREA

Body Surface Area Square Meters	Sponging	Immersion
.59	1	
.50	3	
.48		1
.44	2	1
.42	1	1
.40		2
.38	2	1
.36		1
.32	1	

TABLE IV

DISTRIBUTION OF CASES BY INITIAL TEMPERATURE

Initial Temperature Degrees F.	Sponging	Immersion
102 - 103	5	3
103.2 - 104	1	1
104.2 - 105	4	2
105.2 - 106		1

Degree of temperature drop following the cooling measure. The mean drop in temperature was computed fifteen, thirty, forty-five, and sixty minutes following the cooling measure. It was found that the mean drop in temperature for each time period was greater for patients in Group B who were immersed in warm water gradually lowered to cool water than for patients in Group A who were sponged with cool water. The mean temperature of patients sponged remained the same at thirty minutes following the treatment as it was at fifteen minutes following the treatment. The mean temperature gradually dropped until one hour following the cooling measure it indicated a 0.86 degree drop from the initial temperature.

The mean temperature drop of the patients immersed in a tub of cool water showed a different picture. While fifteen minutes following the treatment the mean drop was 2.8 degrees, one hour following the cooling measure the mean temperature drop was 1.94 degrees. Figure 1 indicates the mean drop in temperature of patients in Group A and Group B fifteen, thirty, forty-five, and sixty minutes following the cooling measure.

While the data for patients immersed were found to be statistically significant, the data for patients sponged were not significant. This information was not included because of the small number of subjects in the study.

Figure 2 indicates the actual degree of temperature change for each patient and the mean temperature change for patients in Group A. Figure 3 indicates the actual degree of temperature change for each patient in Group B and the mean temperature change for patients in Group B.

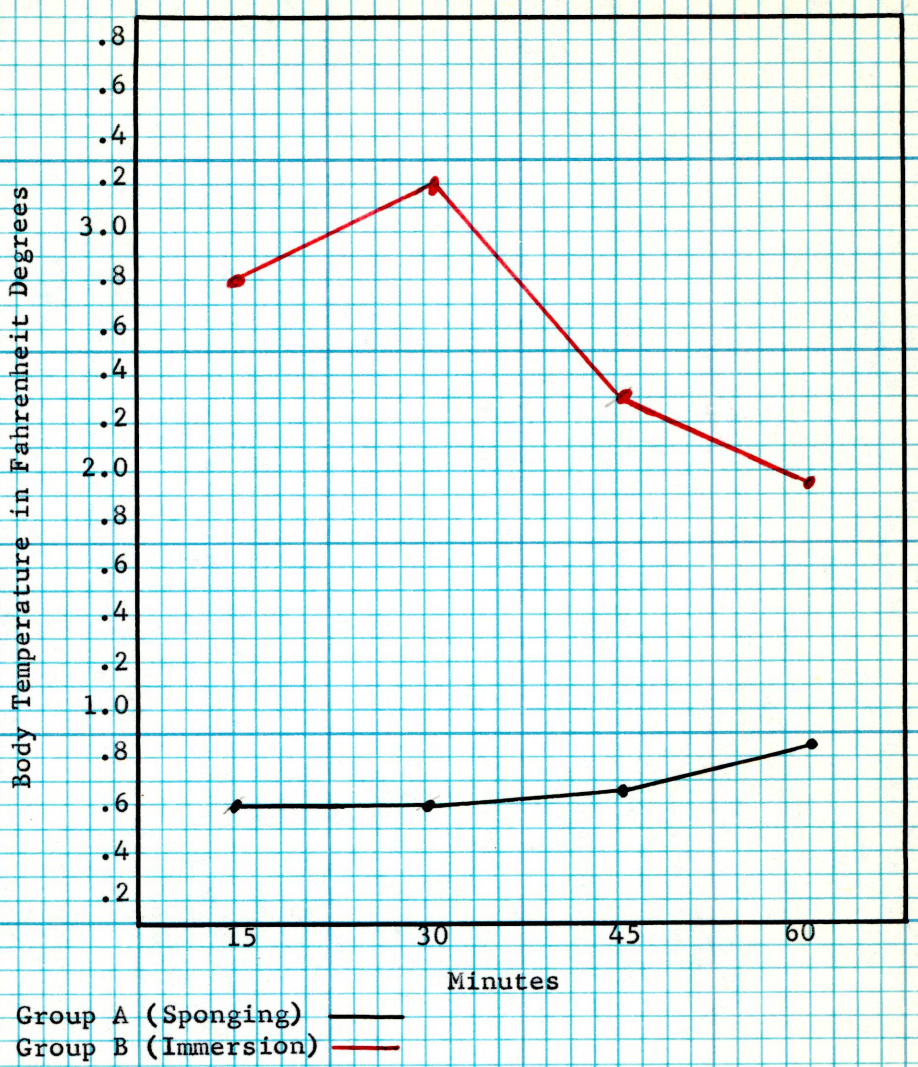

FIGURE 1

MEAN DROP IN TEMPERATURE FOLLOWING THE COOLING MEASURE

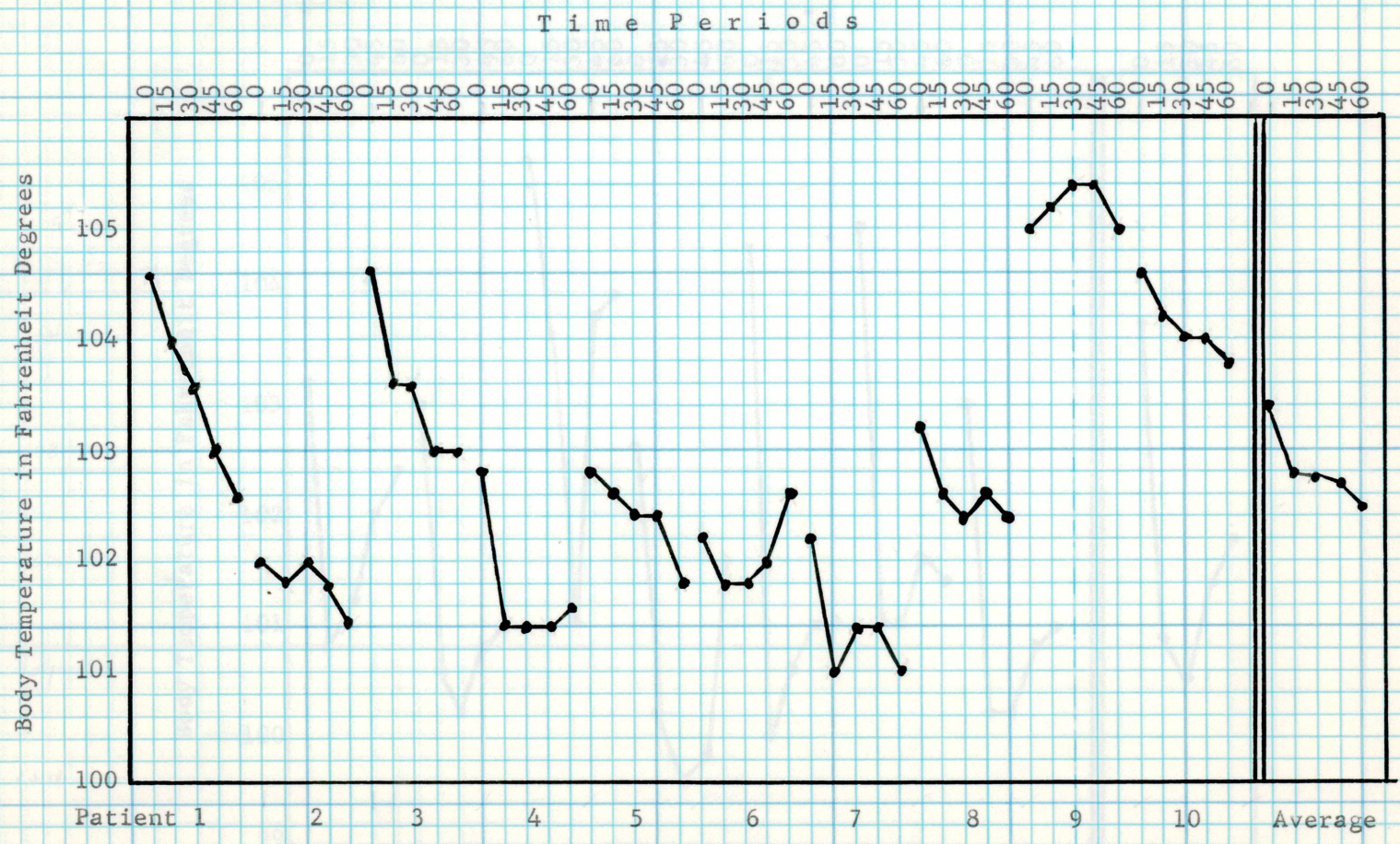

FIGURE 2

THE ACTUAL TEMPERATURES FOR PATIENTS IN GROUP A BEFORE THE COOLING MEASURE AND 15, 30, 45, AND 60 MINUTES FOLLOWING THE PROCEDURE

Medications. As mentioned in Chapters I and II, the administration of antibiotics would have an indirect effect on the degree of temperature change. Eight patients in Group A had received no antibiotics before the administration of the cooling measure. One patient had received one dose of terramycin 50 mg. intramuscularly at 11:00 a.m. while the sponging procedure was administered at 4:40 p.m. of the same day. The other patient had been on antibiotics for three days preceding the day on which the cooling measure was administered.

Six patients in Group B had received no previous medication. One patient had received an initial dose of procaine penicillin on the day preceding the treatment.

Patient number 9 in Group A was given aspirin grains 1-1/2 by rectal suppository forty-five minutes following the cooling procedure. Initially the temperature was 105 degrees F. Fifteen minutes following the sponge, the temperature was 105.2 degrees. Forty-five minutes following the sponge, the temperature was 105.4 degrees. At the end of one hour the temperature was 105 degrees.

Reaction to the treatment. While no particular criteria were set up to evaluate the reaction of the patients to the treatment, it appeared to the investigator that the patients cried more vigorously during the tubbing. Patient number 7 in Group B kept asking to be taken out of the water for approximately the last ten minutes of the treatment.

II. SUMMARY

Analyses were made of the diagnosis, age, body surface area, and initial temperature of the patients in Group A who were sponged with cool water and the patients in Group B who were immersed in tubs of cool water. Analysis of the mean drop in temperatures fifteen, thirty, forty-five, and sixty minutes following the cooling measure indicated that at each time period the mean drop in temperature was greater for patients in Group B than for patients in Group A. At the end of sixty minutes, the mean drop in temperature was 0.86 degrees for the patients in Group A and 1.94 degrees for the patients in Group B. Three of the seventeen patients had received antibiotics prior to the administration of the cooling measure.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

This study was conducted to evaluate the effectiveness of two commonly used cooling measures for reducing fever due to infections. Infants and children age six months to three years whose temperatures were 102 degrees F. rectally or over were selected. The two cooling measures utilized were (1) sponging with water 75 degrees F. and (2) immersion in a tub of water 95 degrees F. which was reduced to 75 degrees F., with the subject remaining in the tub for a total period of twenty minutes.

A review of literature revealed that in the child fever is frequent and often very high. Elevation of temperature due to an infection results from an upset in heat balance with a reduction in heat loss. Various authors have recommended such cooling measures as compresses, sponging, and baths. No studies were found in which cooling measures were used to reduce infectious fevers in infants and children.

The experimental method was used in conducting the research. Ten patients were sponged with cool water and seven patients were immersed in tubs of water. In sponging the patient each body part including the arms, chest and abdomen, legs, and back were covered by ten strokes, five up and five down. The patient was allowed to dry by evaporation. No clothing, with the exception of a diaper,

was replaced for one hour following the cooling procedure. In the immersion procedure the patient was placed in a tub of water 95 degrees F. which was reduced within five to seven minutes to 75 degrees F. After remaining in the tub for a total of twenty minutes, the patient was removed and gently dried with a cotton bath blanket. The clothing was replaced.

On all patients a rectal temperature was taken before beginning the cooling measure and fifteen, thirty, forty-five, and sixty minutes following the procedure. The thermometer was inserted into the rectum to a depth of 2.5 cm. and held in place for three minutes.

Nine diagnoses were recorded. The patients were not matched according to the type of infectious fever. In the age group from six months to eighteen months, the patients in Groups A and B were well matched. While four subjects in the age group nineteen months to thirty-six months were sponged, no subjects in this age group were immersed. The patients in the two groups were fairly well matched according to body surface area and initial temperature. The mean drop in temperature following the cooling measure for patients who were sponged was 0.6 degrees at fifteen minutes, 0.6 degrees at thirty minutes, 0.68 degrees at forty-five minutes, and 0.86 degrees at sixty minutes. The mean drop in temperature following the cooling measure for patients who were immersed was 2.8 degrees at fifteen minutes, 3.2 degrees at thirty minutes, 2.31 degrees at forty-five minutes, and 1.94 degrees at sixty minutes.

II. CONCLUSIONS

The findings of this study would suggest that the hypothesis may be accepted. Immersion in a tub of cool water as used in this study appeared to be more effective in the reduction of fever due to infection than was sponging with cool water. It is recognized that this extremely small series does not allow for unqualified conclusions. It is also recognized that the patients in the two groups were not as equally matched as could be desired.

Other conclusions were drawn:

1. That the mean drop in temperature was greater at all time periods following the cooling procedure in which the patients were immersed in tubs of cool water.

2. That the mean drop in temperature for those patients immersed in cool water was greater fifteen and thirty minutes following the procedure than it was forty-five and sixty minutes following the procedure.

3. That the mean drop in temperature in patients sponged with cool water was the same fifteen and thirty minutes following the procedure, namely 0.6 degrees.

4. That the mean drop in temperature for patients sponged with cool water was the lowest sixty minutes following the procedure, namely 0.86 degrees.

5. That the patients immersed in tubs of cool water appeared to be more distressed by the treatment than those patients sponged with cool water. Perhaps the procedure would be less traumatic and equally effective if the temperature of the water were not so cold.

III. RECOMMENDATIONS

As a result of the findings of this study, the following recommendations were made:

1. That further and more extensive research be conducted to evaluate the effectiveness of the two cooling measures used in this study.

2. That study be made of the effectiveness of other cooling measures commonly used by nursing personnel.

3. That study be made of the effectiveness of sponging and tubbing using different degrees of temperature of water.

4. That study be made of the effectiveness of sponging and tubbing over a longer time period.

5. That a comparison be made of the effectiveness of aspirin and various cooling measures for reducing fever.

6. That a comparison be made of the effectiveness of aspirin and aspirin in combination with a cooling measure.

7. That study be made of the effectiveness of cooling measures for reducing fever due to causes other than infections.

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APPENDIX

APPENDIX

FORM FOR COLLECTING DATA

Name: **Procedure:**

Date: **Time:**

Birthdate:

Weight: **Temperatures**

Before:

Height: **After 15 Minutes:**

30 Minutes:

Diagnosis: **45 Minutes:**

60 Minutes:

Medications:

Comments:

LOMA LINDA UNIVERSITY

School of Graduate Studies

A STUDY OF THE EFFECTIVENESS OF TWO COOLING MEASURES FOR REDUCING FEVER IN CHILDREN

by

Marilyn Catherine Kueffner

An Abstract of a Thesis

in Partial Fulfillment of the Requirements

for the Degree Master of Science

in the Field of Nursing

June 1962

ABSTRACT

The purpose of this study was to evaluate the effectiveness of two commonly used cooling measures for reducing fever due to infections. Seventeen infants and children age six months to three years with a rectal temperature of 102 degrees or over were selected.

The experimental method was the research approach used. The subjects were divided into two groups, A and B. The ten patients in Group A were sponged with water 75 degrees F. Each body part including the arms, chest and abdomen, legs, and back were covered by ten strokes, five up and five down. The patients were allowed to dry by evaporation. The seven patients in Group B were immersed in tubs of water 95 degrees F. which was gradually reduced to 75 degrees F., the patients remaining in the tubs for a total of twenty minutes. Immediately following the procedure, the patients were gently dried with a cotton bath blanket.

A rectal temperature was taken immediately before the administration of the cooling measure and fifteen, thirty, forty-five, and sixty minutes following the procedures.

Analyses were made of the diagnosis, age, and body surface area of the patients. An analysis of the mean drop in temperature indicated that the temperature of patients immersed in cool water was lower for all time periods than was the temperature of patients sponged with cool water. The mean drop in temperature for patients who were sponged was the same fifteen and thirty minutes following the procedure, namely 0.6 degrees F. At the end of one hour the mean drop was 0.86 degrees

F. The mean drop in temperature for patients who were immersed in cool water was lowest thirty minutes following the treatment and was 1.94 degrees F. at the end of one hour.

Because of the small number of subjects it was impossible to draw unqualified conclusions, but it would appear that immersion in a tub of warm water gradually lowered to cool water is more effective than sponging with cool water for reducing fever due to infections.